flight path

Saguaro Feeding by Desert Birds: an ABA-supported Project

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Saguaros (*Carnegiea gigantea*) are spectacular tree-like cacti that define Sonoran Desert landscapes. They can live for several human generations, and during their long lives can play a number of crucial ecological roles.

Large saguaros provide natural housing. The extensive excavations of Gilded Flickers and Gila Woodpeckers provide nest sites for the primary cavity-nesters themselves, as well as for a variety of secondary cavity nesters that run the gamut from Purple Martins and Brown–crested Flycatchers to Elf Owls and American Kestrels.

Saguaros also provide food. During the spring and early summer—the driest months in the desert—saguaros produce enormous flower and fruit crops that feed innumerable desert denizens. A mature saguaro will produce anywhere from 300 to 1,000 flowers each year. These flowers secrete copious nectar that feeds bees, birds, and bats. Typically, only about one-half of these flowers receive enough pollen to develop into fruit. Saguaro evidently evolved to be eaten by animals. The rich red pulp of a single fruit yields enough water and nutrients to meet the daily needs of a largish bird, such as a White-winged Dove. Saguaros are important sources of food and water in the Sonoran desert not only because they produce a lot of nectar and fruit, but also because they produce these resources reliably. When it rains, these cacti store thousands of liters of water in their massive stems, and this stockpile of moisture allows them to bloom and produce fruit even in dry years. The original human inhabitants of the Sonoran Desert—the Tohono, O'odham, Pima, and Seri peoples—relied on the saguaro for millennia.

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Saguaros, found most commonly in Arizona, southeastern California, and Sonora, provide significant sustenance and cover for numerous birds. Stable isotope analysis has revealed that more than fifty percent of the diet of Gila Woodpeckers is comprised of saguaro fruit.

While casual observations suggest that the saguaro is an important food and water resource for birds and other desert animals, the importance of saguaro as a water and nutrient source for wildlife rather surprisingly has never been quantified. In 1999, a grant from the American Birding Association and National Fish and Wildlife Foundation provided us with the opportunity to gain some insight into the importance of the saguaro as a nutrient resource to the desert bird community. (Our effort was connected to the ABA Tucson Convention, with the convention adopting the effort as its official convention project.)

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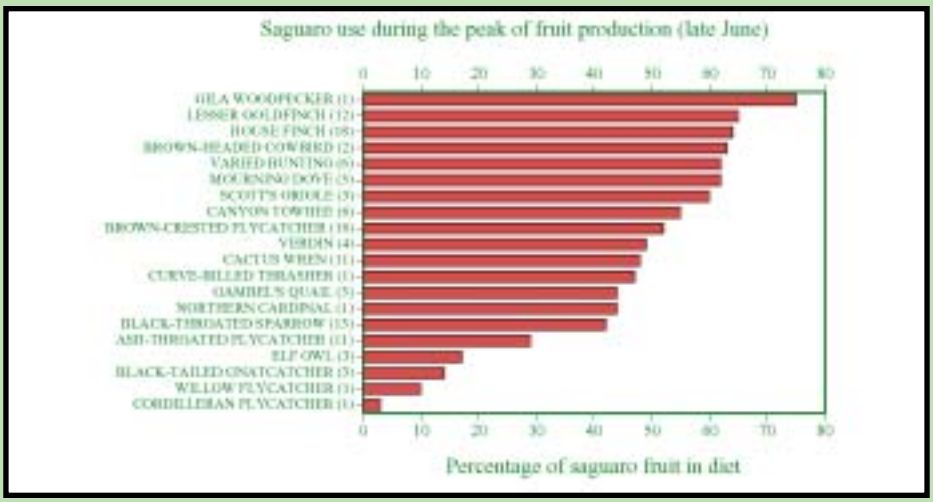
We used a new technique, stable isotope analysis, to quantify how important saguaro is in the diet of desert birds.

Discovering what foods birds eat can be very difficult. Indeed, assessing the relative importance of different food types to a bird's diet can be daunting. Even the most avid and devoted birder would confirm the magnitude of the task after a few minutes of following a bird and attempting to identify the food it consumes. This problem is complicated by the fact that some foods are more or less digestible than others and thus have different nutritional values. Some foods may contribute to the bulk of a bird's diet, but may be relatively unimportant for a bird's nutrition. We can spend many hours observing birds feeding on saguaro fruits and never determine precisely how important saguaros are for them.

A quirk in the saguaro's biology facilitated our task. Saguaros have a peculiar form of photosynthesis with the rather formidable name of Crassulacean Acid Metabolism (CAM). This photosynthetic pathway enriches saguaro tissues with a heavy isotope of carbon (carbon 13). The nectar and fruit pulp of saguaros contain more carbon 13 than any other resources available in the desert.

It is more or less literally true that animals are what they eat. Therefore, the carbon composition of saguaro fruit is transferred into the tissues of the birds that eat it. These observations suggest a simple method to measure how important saguaro is to birds: we collect a tiny blood sample from a bird, release the bird, and then go to the laboratory to measure the carbon isotopes in the sample. The relative abundance of carbon 13 will tell us how much saguaro fruit was incorporated into the bird's blood. The carbon isotope ratios of the saguaro's fruit pulp and floral nectar provide a simple way of quantifying the transfer of nutrients from the saguaro into the tissues of birds.

Every week from May until the beginning of September we used mist nets to capture desert birds. We tried to catch as many members of the bird community as possible. We collected the blood samples needed to measure their carbon isotope ratios.



Saguaro fruit utilization as a proportion of total diet for each species measured during the third week in June. Values shown are means, and the sample sizes appear next to the species name.

We found that this bird community uses saguaros extensively. From the middle of June until the end of July, saguaro fruit accounted for approximately 35 to 40 percent of the bird community's entire food intake. If we look more closely, at a period of intensive sampling during a week in late June (see the chart), we see that saguaro fruit was used not only by frugivores, but by birds in many dietary guilds. For example, granivorous species such as Lesser Goldfinches, House Finches and Canyon Towhees used saguaro fruit heavily. Our stable isotope analyses tell us that saguaro fruit accounted for 65, 64, and 55 percent of those species' diets, respectively, during this period. However, and perhaps more importantly, we see many unexpected species—insectivorous species—also making heavy use of saguaro fruit during its period of peak abundance (see the chart). Stable isotopes revealed that more than 50 percent of the diet of Gila Woodpeckers, Brown-crested Flycatchers, and Scott's Orioles was comprised of saguaro fruit. These species breed in the Sonoran Desert during the period of saguaro fruit production, and such intense use suggests that the saguaro may be an absolutely critical resource for many of them.

Our data provided a first glimpse of the role that saguaro plays as a nutrient and water resource for the bird community. We know that most species feed from ripe fruit still attached to the plant. Saguaro fruits are about 75 percent water by mass. As a consequence, many of the species consuming saguaro fruit may be able to meet most of their water requirements from eating the succulent fruit. This can be important for animals that live in an environment where water is scarce and where shade air temperatures can approach 120° F (50 °C).

We are grateful for the ABA funding because it allowed us to use a sophisticated technique to garner insight into the key ecological role that the saguaro plays in the Sonoran Desert. This information is the first of its kind. We know of no other study that attempts to quantify the flow of nutrients and water from a single species of plant into a community of consumers. In addition to its intrinsic scientific value, we hope that our study—still in a preliminary stage—will have applied consequences. We anticipate that it will provide resource managers and the public with a tool to examine how changes in saguaro populations may affect the bird community and other wildlife populations. We trust that our study will provide added impetus for the conservation of this beautiful and important desert plant.